

# SLHC issues - overview

- Main points for this session:
  - Focus on the long term optimized use of the LHC machine, and its experiments (well beyond 2020) in order to maximize physics output of the LHC project
  - Phase I changes are needed, but more substantial changes are needed in 2016-2018 for machine and experiments to reach higher luminosities
  - Today we will learn more about the phase I changes, and attempt to move towards a common framework for planning the phase II changes
    - The formal decisions about the phase II changes are planned for 2010-11.

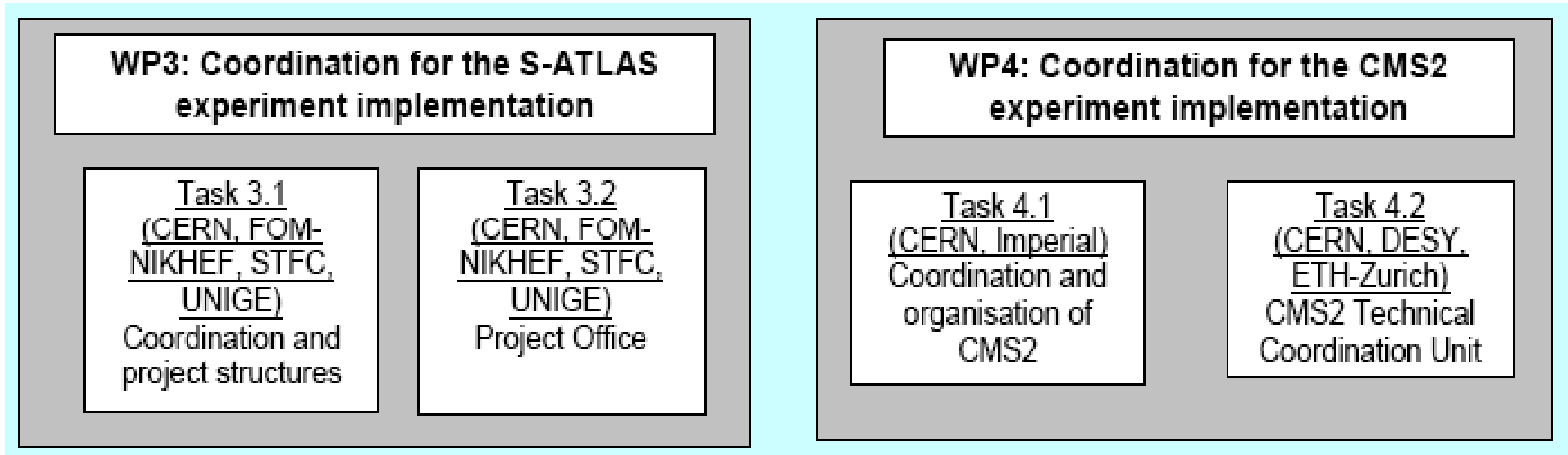
# ATLAS/CMS upgrades

- Planning based on the assumption that it is well worth increasing the integrated luminosity of LHC by a factor 4-7 (phase II upgrade), and also that Inner Detectors are needed with similar performances as today.
- The phase II experimental changes involved replacements of the full IDs in both experiments, and additionally changes in machine interfaces (beampipe, shielding, machine elements), electronics, triggering, and some calorimeter and muons changes ....
- Some of these changes – for example the most costly ones as the ID changes – are needed in any scenario that keeps LHC running beyond 2017.
- Costs are 180-220 MChf per experiments, with at least 60% in the ID changes (these cost estimates were made 2-3 years ago and should be remade – unlikely to be less as we have learnt more)

# Upgrade projects

- Both in ATLAS and CMS the detector upgrades work is an integral part of the collaboration activities and most groups have an involvement at this stage, or are getting involved
  - Supported by national programs (typically from 2005) and EU on the technical coordination, common project side
- Common projects at CERN have also started, based CERN R&D funding, and also supported by EU funds
- Two EU proposals (only one approved) constructed to support these activities, with focus on common activities
  - SLHC-PP has a focus on project development and planning, and gives a time-schedule towards approval of the SLHC project
  - DevDet has a focus of R&D infrastructures (electronics, software, irradiation facilities and testbeams). This project was not approved, but several of the activities will (need to) be carried out anyway during the SLHC R&D phase

# SLHC – PP: Deliverables and Timescales



- Objectives for these WPs:
  - Establish the formal structures needed for the ATLAS/CMS upgrade construction project, and through Technical Documentation, Cost and Schedule planning, establish an initial MoU for the Upgrade Construction.
  - Establish a Project Office to address the critical technical integration and coordination issues of the new detectors, and the technical and managerial tools needed for the project planning and follow up.

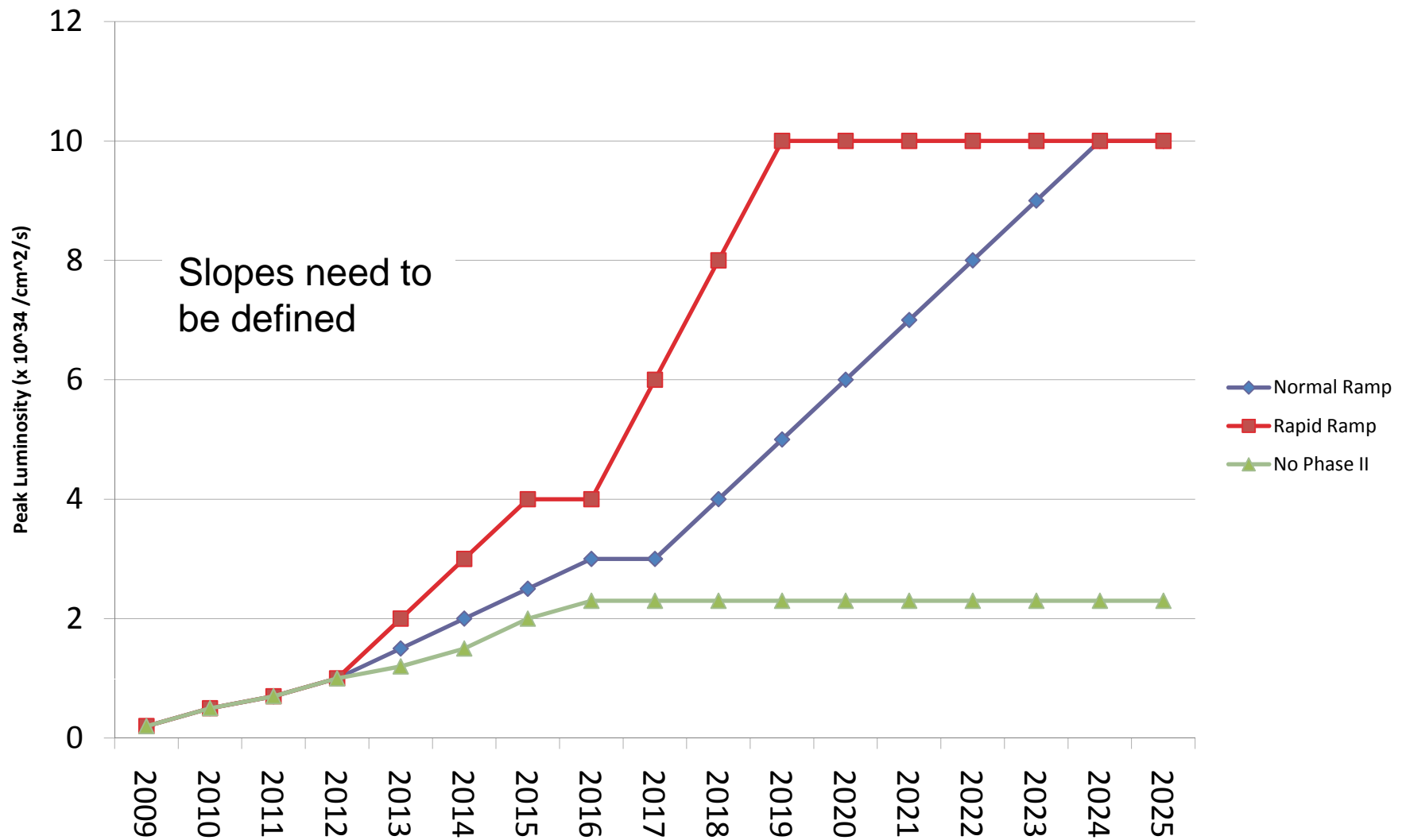
# LHCC coordination

- The next slides show what we (machine, experiments etc) need to agree on (i.e give a consistent picture of inside and outside CERN)
  1. Luminosity and upgrade schedules – with their uncertainties
  2. Timescale for documents needed for technical planning and funding requests (EoI?, Lol, TP, TDRs, CORE cost books, (I)MoUs), and also reviews for experiments and machine – required to moving from R&D to real upgrade projects by 2010-11
- Note that the next slides show EXAMPLES – not agreed scenarios

# Three scenarios

Year	Normal Ramp			Rapid Ramp			No Phase II		
	Peak Lumi	Annual Integrated	Total Integrated	Peak Lumi	Annual Integrated	Total Integrated	Peak Lumi	Annual Integrated	Total Integrated
2009	0.2	12	12	0.2	12	12	0.2	12	12
2010	0.5	30	42	0.5	30	42	0.5	30	42
2011	0.7	42	84	0.7	42	84	0.7	42	84
2012	1	60	144	1	60	144	1	60	144
2013	1.5	90	234	2	120	264	1.2	72	216
2014	2	120	354	3	180	444	1.5	90	306
2015	2.5	150	504	4	240	684	2	120	426
2016	3	180	684	4	0	684	2.3	138	564
2017	3	0	684	6	360	1044	2.3	138	702
2018	4	240	924	8	480	1524	2.3	0	702
2019	5	300	1224	10	600	2124	2.3	138	840
2020	6	360	1584	10	600	2724	2.3	138	978
2021	7	420	2004	10	600	3324	2.3	138	1116
2022	8	480	2484	10	600	3924	2.3	138	1254
2023	8	480	2964	10	600	4524	2.3	138	1392
2024	10	600	3564	10	600	5124	2.3	138	1530
2025	10	600	4164	10	600	5724	2.3	138	1668

### Peak Luminosity vs Year

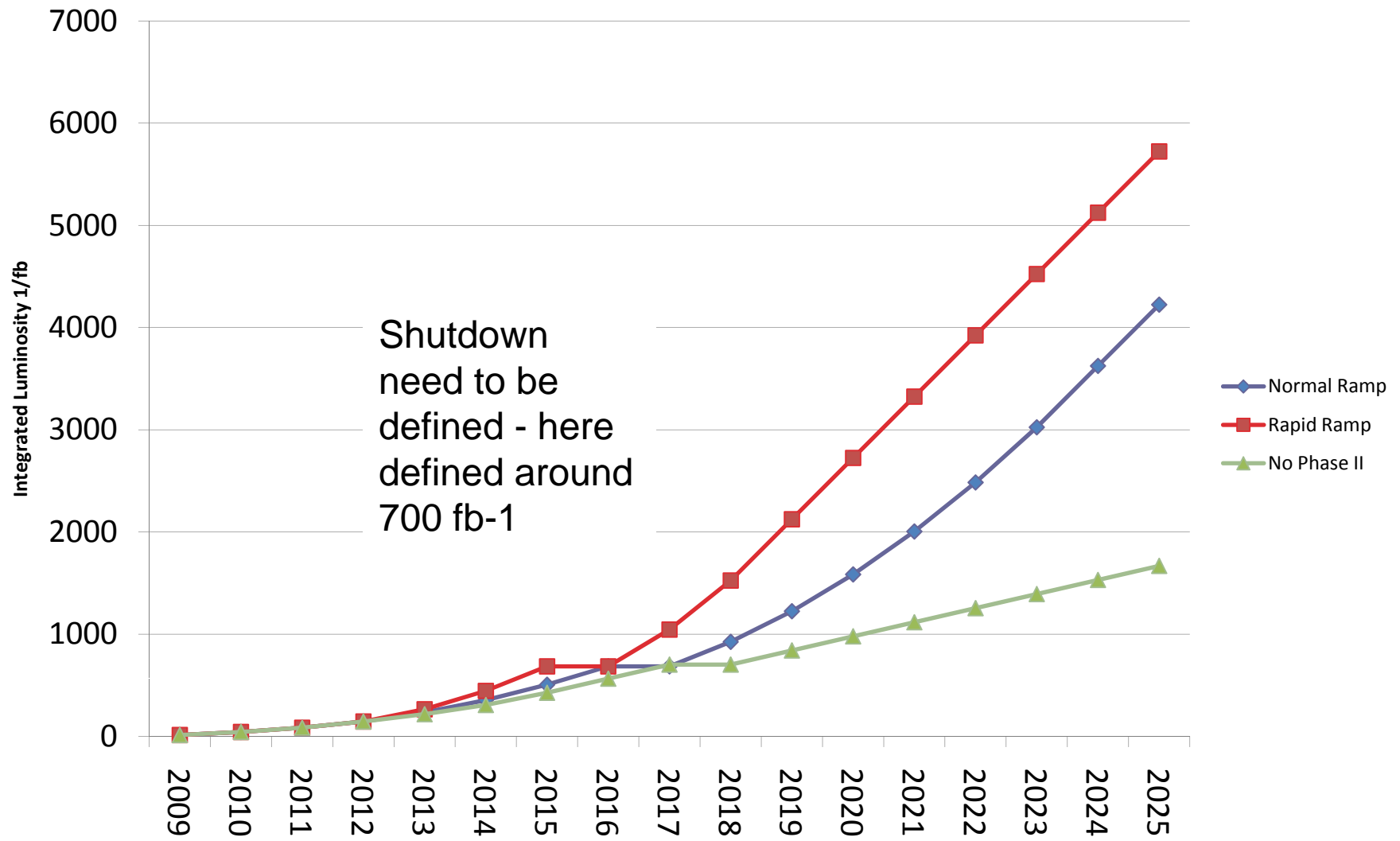


Slopes need to be defined

Different scenarios also here?

Steinar Stapnes, LHCC closed session, 20/02/2008

### Total Integrated Luminosity vs Year



Steinar Stapnes, LHCC closed session,  
20/02/2008



# Timescale for key documents – phase II

1. EoI (short documents similar to the one made by CMS) by Feb 09 ? Is this needed ?
2. LoI late 2009 (during the run in 2009 I think it is hard) including updated cost estimates.
3. Improved cost estimates, more detailed schedules and scope, overall Technical Proposal for phase II mid 2010. This is the basis for approval of the phase II projects for the experiments.

TDRs will follow the TP as soon as feasible, maybe several of them for the various changes (ID, beam-interface, muons, etc, etc) at different timescales.

They are also reviewed of course, but more on the technical level - than from approval point of the view of the overall upgrade project.

# Timescale for key documents – phase I

- CMS has foreseen a Technical Proposal for phase I changed mid 2009 (i.e one year ahead of the phase II TP) - seems aggressive but maybe correct ?
- Likely that large changes (typically related to the PIXEL changes) related to the phase I 2012-2013 will need a TP
- Some projects to improve the detector before phase II can also be dealt with case by case, depending on timescales, and size of project.

# Issues in relation to LHCC

Main areas where LHCC involvement is desired – as summary and for discussion:

**1. Official recognition of SLHC project with a defined schedules** Partly already done through European strategy document + CERN council White paper funding + approved SLHC-PP project. However some funding agencies are waiting for a more clear signs – or at least a consistent scenario for the SLHC project.

**2. Coherence in SLHC experiments project development the coming years:**

- Interface between experiments and accelerator (related to machine parameters as BCO rates, forward region layout, access, etc)
- Timescale for documentations and reviews (EoI, LoI, TP, TDR, MoU etc)
- Common facilities and efforts

**3. Make use of ATLAS/CMS internal reviews in LHCC reviewing process** related to upgrades. Promote **common R&D when appropriate**, to be peer-reviewed by LHCC, in coherence with **experiment-specific R&D**. This includes the CERN R&D projects.

# More

# SLHC-PP project

- FP7 EU project, submitted May 2007, approved July 2007 (<http://cern.ch/SLHC-PP/>)
- “Preparatory Phase” project, part of EU ESFRI road map projects.
- Total cost 15.6 M€, of which 5.2 M€ paid by EU.
- 17 collaborating laboratories
- Covers coordination and technical work for accelerator and experiments
- Official project start date: April 2008 (3 year project)
  - Kick off meeting 8-9.4 include several open presentations
- **Note: Outlines a timescale for the equivalents of Lol, TDR and initial MoU for the experiment upgrades**